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Weather Bureau Technical News

ISOTOPE-POWERED AUTOMATIC WEATHER STATION

The latest development in the automatic observation of weather is the incorporation of a radio-isotope power plant into the apparatus of automatic stations. This allows unattended operation of the station up to the limit of instrument life and eliminates the difficulties met with in other automatic stations from lack of a continuous power source. The first such station was set up in August on or near Graham Island in the Canadian Arctic about halfway between the Joint Canadian-United States Arctic Weather Stations at Eureka and Resolute. Power is generated by the heat spontaneously produced by radio active decay of pellets of strontium-90, in the form of strontium titanate, enclosed in a small (5-inch) shielded cylindrical capsule. The heat is transformed directly into a continuous flow of electricity by 60 pairs of thermocouples arranged like spokes around the cylindrical heat source. The whole generator is shielded in 4.4 inches of lead and covered by an outer skin of stainless steel. The overall dimensions are 20 inches long by 18 inches in diameter.

The generator cylinder is the bottom element in a larger cylindrical container 8 feet long. The top compartments of this house the electrical apparatus, recording equipment, radio transmitters, and the barometer. Excess heat from the generator serves to maintain an interior operating temperature of 70° F. The anemometer and thermometer are exposed on a mast beside the cylinder, the lower 5 feet of which is buried in the ground.

Observations of wind direction (to nearest 10° heading), wind speed (0 to 150 kt. ± 1 kt., 1 and 8 minute average), pressure (28.00 to 32.00 in., ± 0.02 in.), and temperature (–75° to +120° F., $\pm 1^\circ$ F.) is transmitted by radio in 8 bit binary digital form once every 3 hours simultaneously on two frequencies, 3.36 and 4.97 megacycles. The transmitter output is 250 watts on each frequency with range up to 1500 miles depending on the frequency. The transmission consists of call letters and data measurements plus one repeat. Provision has been made in the package for

measuring other elements such as precipitation, humidity, sky cover, etc., whenever suitable sensors become available.

The measuring and transmitting equipment are designed and fabricated to provide reliability consistent with the long life of the isotope, to use a minimum of electricity, and to produce accurate weather data in usable form. Since the generator sustains no wear from moving parts, long-term maintenance-free operation is possible. The generator could power the station for more than ten years.

Although these stations will always be located in remote or completely uninhabited areas such as the present site, great care was taken in the development of a safe fuel form and adequate, reliable shielding. Strontium becomes a biological problem only if it is absorbed by some living organism. This danger can be eliminated by using an insoluble compound. To provide at the same time a fuel material dense enough to conserve space and relatively easy to produce, strontium titanate was selected. This compound remains stable even beyond its melting point of 3000° F., and its rate of solubility in fresh water is so low it has not been measured. In salt water its solubility is measured in parts per billion. The shielding within the generator consists of several layers of an alloy called Hastelloy-C. It would take centuries to corrode, even if immersed in sea water. The outside shielding of the generator cylinder is $\frac{3}{4}$ ton of lead with a final covering of stainless steel. The whole generator is designed so sturdily that it could survive a plane crash or an explosion without releasing its fuel.

The station was designed and built by the nuclear division of the Martin Company, Baltimore, Md., under a contract with the U.S. Atomic Energy Commission, Office of Isotopes Development in cooperation with the U.S. Weather Bureau. The site was suggested by the Department of Transport of Canada and the station was installed by a joint Canadian and United States work party.